

Compendium of Measures To Control *Chlamydia psittaci* Infection Among Humans (Psittacosis) and Pet Birds (Avian Chlamydiosis), 2000

Summary

Psittacosis — also known as parrot fever, and ornithosis — can cause severe pneumonia and other serious health problems among humans. Approximately 813 cases of psittacosis (infection with *Chlamydia psittaci*) were reported to CDC from 1988 through 1998, and most resulted from exposure to infected pet birds, usually cockatiels, parakeets, parrots, and macaws. In birds, *C. psittaci* infection is referred to as avian chlamydiosis (AC). Infected birds shed the bacteria through feces and nasal discharges. This compendium provides information about psittacosis and AC to public health officials, physicians, veterinarians, the pet bird industry, and others concerned about controlling these diseases and protecting public health. The recommendations in this compendium provide standardized procedures for controlling AC in birds, a vital step to protecting human health.

THE NASPHV COMMITTEE

William B. Johnston, DVM, Dpl. ACVPM; Chair
Millicent Eidson, MA, DVM, Dpl. ACVPM
Kathleen A. Smith, DVM, MPH
Mary Grace Stobierski, DVM, MPH, Dpl. ACVPM

CONSULTANTS TO THE COMMITTEE

Lisa A. Conti, DVM, MPH, Dpl ACVPM; Council of State and Territorial Epidemiologists (CSTE)
Keven Flammer, DVM, Dpl ABVP (Avian); Association of Avian Veterinarians
Kevin F. Reilly, DVM, MPVM; AVMA Council on Public Health and Regulatory Medicine
Thomas N. Tully, Jr., DVM, MS, Dpl ABVP (Avian); Association of Avian Veterinarians
Richard E. Besser, MD; Centers for Disease Control and Prevention (CDC)
Branson Ritchie, DVM, PhD, Dpl ABVP (Avian); Association of Avian Veterinarians

ENDORSED BY:

American Veterinary Medical Association (AVMA); Council of State and Territorial Epidemiologists (CSTE); Association of Avian Veterinarians (AAV)

Address all correspondence to:

Dr. William B. Johnston; Alabama Department of Public Health; Epidemiology, Suite 1310; P.O. Box 303017; Montgomery, AL 36130-3017. Copies are also available electronically at the CDC website: <http://www.cdc.gov/ncid/> and the AVMA website: www.avma.org

INTRODUCTION

Chlamydia psittaci is a bacterium that can be transmitted from pet birds to humans. In humans, the resulting infection is referred to as psittacosis (also known as parrot fever, and ornithosis). Psittacosis often causes influenza-like symptoms and can lead to severe pneumonia and nonrespiratory health problems. With proper treatment, the disease is rarely fatal. From 1988 through 1998, CDC received reports of 813 cases of psittacosis (1), which is an underestimate of the actual number of cases because psittacosis is difficult to diagnose and cases often go unreported. During the 1980s, approximately 70% of the psittacosis cases with a known source of infection resulted from exposure to pet birds. The largest group affected (43%) included bird fanciers and owners of pet birds. Pet shop employees accounted for an additional 10% of cases. Other persons at risk include pigeon fanciers and persons whose occupation places them at risk for exposure (e.g., employees in poultry slaughtering and processing plants, veterinarians, veterinary technicians, laboratory workers, workers in avian quarantine stations, farmers, wildlife rehabilitators, and zoo workers). Because human infection can result from brief, passing exposure to infected birds or their contaminated droppings, persons with no identified leisure-time or occupational risk can become infected.

In this report, *C. psittaci* infection in birds is referred to as avian chlamydiosis (AC). *C. psittaci* has been isolated from approximately 100 bird species and is most commonly identified in psittacine (parrot-type) birds, especially cockatiels and parakeets. Among caged, nonpsittacine birds, infection with *C. psittaci* occurs most frequently in pigeons, doves, and mynah birds. Disease in canaries and finches is less frequently diagnosed.

The recommendations in this compendium provide standardized procedures for controlling AC in the pet bird population, an essential step in efforts to control psittacosis among humans. Development of and participation in aviary and pet shop accreditation programs is encouraged. This compendium is intended to guide public health officials, physicians, veterinarians, the pet bird industry, and others concerned with the control of *C. psittaci* infection and the protection of public health.

PART I. INFECTION AMONG HUMANS (PSITTACOSIS)

Transmission

Because several diseases affecting humans can be caused by other species of *Chlamydia*, the disease resulting from the infection of humans with *C. psittaci* is referred to as psittacosis. Most *C. psittaci* infections in humans result from exposure to pet psittacine birds. However, transmission has been documented from free-ranging birds, including doves, pigeons, birds of prey, and shore birds. Infection with *C. psittaci* usually occurs when a person inhales the organism, which has been aerosolized from dried feces or respiratory secretions of infected birds. Other means of exposure include mouth-to-beak contact and the handling of infected birds' plumage and tissues. Even brief exposures can lead to symptomatic infection; therefore, some patients with psittacosis may not recall or report having any contact with birds.

Mammals occasionally transmit *C. psittaci* to humans. Certain strains of *C. psittaci* infect sheep, goats, and cattle, causing chronic infection of the reproductive tract, placental insufficiency, and abortion in these animals. These strains of *C. psittaci* are transmitted to persons when they are exposed to the birth fluids and placentas of infected animals. Another strain of *C. psittaci*, feline keratoconjunctivitis agent, typically causes rhinitis and conjunctivitis in cats. Transmission of this strain from cats to humans rarely occurs.

Person-to-person transmission has been suggested but not proven. Standard infection-control precautions are sufficient for patients with psittacosis, and specific isolation procedures (e.g., a private room, negative pressure air flow, and masks) are not indicated.

Clinical Signs and Symptoms

The onset of illness typically follows an incubation period of 5–14 days, but longer periods have been reported. The severity of this disease ranges from inapparent illness to systemic illness with severe pneumonia. Before antimicrobial agents were available, 15%–20% of persons with *C. psittaci* infection were reported to have died. However, <1% of properly treated patients now die as a result of the infection.

Persons with symptomatic infection typically have abrupt onset of fever, chills, headache, malaise, and myalgia. They usually develop a nonproductive cough that can be accompanied by breathing difficulty and chest tightness. A pulse-temperature dissociation (fever without elevated pulse), enlarged spleen, and rash are sometimes observed and are suggestive of psittacosis in patients with community-acquired pneumonia. Auscultatory findings may underestimate the extent of pulmonary involvement. Radiographic findings include lobar or interstitial infiltrates. The differential diagnosis of psittacosis-related pneumonia includes infection with *Coxiella burnetii*, *Mycoplasma pneumoniae*, *Chlamydia pneumoniae*, *Legionella* species, and respiratory viruses such as influenza. *C. psittaci* can affect organ systems other than the respiratory tract and result in endocarditis, myocarditis, hepatitis, arthritis, keratoconjunctivitis, and encephalitis. Severe illness with respiratory failure, thrombocytopenia, hepatitis, and fetal death has been reported among pregnant women.

Case Definition

CDC and the Council of State and Territorial Epidemiologists established case definitions for epidemiologic purposes (2). These definitions should not be used as the sole criteria for establishing clinical diagnoses. A patient is considered to have a *confirmed* case of psittacosis if clinical illness is compatible with psittacosis and the case is laboratory confirmed by one of three methods: a) *C. psittaci* is cultured from respiratory secretions; b) antibody against *C. psittaci* is increased by fourfold or greater (to a reciprocal titer of 32 between paired acute- and convalescent-phase serum specimens collected at least 2 weeks apart) as demonstrated by complement fixation (CF) or microimmunofluorescence (MIF); or c) immunoglobulin M antibody against *C. psittaci* as detected by MIF (to a reciprocal titer of 16). A patient is considered to have a *probable* case of psittacosis if clinical illness is compatible with psittacosis and a) the patient is epidemiologically linked to a confirmed case of psittacosis or b) a single antibody titer 32, demonstrated by CF or MIF, is present in at least one serum specimen obtained after onset of symptoms.

Diagnosis

Most diagnoses are established by using serologic methods in which paired sera are tested for chlamydial antibodies by CF test. However, because chlamydial CF antibody is not species-specific, high CF titers also may result from *C. pneumoniae* and *C. trachomatis* infections. Acute-phase serum specimens should be obtained as soon as possible after the onset of symptoms, and convalescent-phase serum specimens should be obtained 2 weeks after the onset of symptoms. Because antibiotic treatment can delay or diminish the antibody response, a third serum sample might help confirm the diagnosis. All sera should be tested simultaneously at the same laboratory. If the patient's epidemiologic and clinical history indicate a possible diagnosis of psittacosis, MIF and polymerase chain reaction (PCR) assays can be used to distinguish *C. psittaci* infection from infection with other chlamydial species. The infectious agent also can be isolated from the patient's sputum, pleural fluid, or clotted blood during acute illness and before treatment with antimicrobial agents; however, culture of *C. psittaci* is performed by few laboratories because of technical difficulty and safety concerns.

Laboratories that test human specimens for *C. psittacosis*

Information about laboratory testing is often available from state public health laboratories. Few commercial laboratories have the capability to differentiate *Chlamydia spp.* The following labs accept human specimens to confirm *C. psittaci*. Other sources may be available.

Respiratory Diseases Laboratory Section (CDC, Atlanta, GA)	(404)639-3563	MIF, CF, culture, PCR
Microbiology Research Labs (Cypress, CA)	800-445-4032	IFA, PCR, culture
Labcorp Services (Burlington, NC)	800-334-5161	culture, polyclonal Ab
Specialty Labs (Santa Monica, CA)	800-421-4449	MIF

Treatment

Tetracyclines are the drugs of choice. Most patients respond to oral therapy (100 mg of doxycycline administered twice a day or 500 mg of tetracycline hydrochloride administered four times a day). For initial treatment of severely ill patients, doxycycline hyclate may be administered intravenously at a dosage of 4.4 mg/kg (2 mg/lb) body weight per day divided into two infusions per day (up to 100 mg per dose). Remission of symptoms usually is evident within 48–72 hours. However, relapse can occur, and treatment must continue for at least 10–14 days after fever abates. Although its *in vivo* efficacy has not been determined, erythromycin probably is the best alternative agent in patients for whom tetracycline is contraindicated (e.g., children aged <9 years and pregnant women).

PART II. INFECTION AMONG BIRDS (AVIAN CHLAMYDIOSIS)

Transmission

C. psittaci is excreted in the feces and nasal discharges of infected birds. The organism is resistant to drying and can remain infectious for several months. If infected, birds can appear healthy and shed the organism intermittently. Shedding may be activated by stress factors, including shipping, crowding, chilling, and breeding.

Clinical Signs

The time between exposure to *C. psittaci* and the onset of illness ranges from 3 days to several weeks. However, active disease may appear years after exposure. Whether the bird exhibits acute or chronic signs of illness or dies depends on the species of bird, virulence of the strain, infectious dose, stress factors, age, and extent of treatment or prophylaxis.

Signs of AC include lethargy, anorexia, and ruffled feathers, similar to other systemic illnesses. Other signs include serous or mucopurulent ocular or nasal discharge, diarrhea, and excretion of green to yellow-green urates. Anorectic birds may produce sparse, dark green droppings, followed by emaciation, dehydration, and death.

Case Definition

A *confirmed* case of AC is defined on the basis of at least one of the following laboratory results: a) isolation of *C. psittaci* from a clinical specimen, b) identification of chlamydial antigen by immunofluorescence (fluorescent antibody [FA]) of the bird's tissues, c) a greater than fourfold change in serologic titer in two specimens from the bird obtained at least 2 weeks apart and assayed simultaneously at the same laboratory, or d) identification of *C. psittaci* within macrophages in smears stained with Gimenez or Macchiavello stain or sections of the bird's tissues.

A *probable* case of AC is defined as compatible illness and at least one of the following laboratory results: a) a single high serologic titer in one or more specimens obtained after the onset of signs or b) the presence of *C. psittaci* antigen (identified by enzyme-linked immunosorbent assay [ELISA], PCR, or FA) in feces, a cloacal swab, or respiratory or ocular exudates.

A *suspected* case of AC is defined as a) compatible illness that is epidemiologically linked to another case in a human or bird but that is not laboratory confirmed, b) a subclinical infection with a single high serologic titer or detection of chlamydial antigen, c) compatible illness with positive results from a nonstandardized test or a new investigational test, or d) compatible illness that is responsive to appropriate therapy.

Diagnosis

Several diagnostic methods are available for identifying AC in birds (Appendix A).

Treatment

Treatment should be supervised by a licensed veterinarian (Appendix B).

PART III. RECOMMENDATIONS AND REQUIREMENTS

Recommendations for Controlling Infection Among Humans and Birds

To prevent transmission of *C. psittaci* to people and birds, the following control measures are recommended:

- Protect at risk people. All persons in contact with infected birds should be informed about the nature of the disease. They should be instructed to wear protective clothing, gloves, a disposable surgical cap, and a respirator with an N95 rating or a higher-efficiency respirator when cleaning cages or handling infected birds. Surgical masks may not be effective in preventing transmission of *C. psittaci*. When necropsies are performed on potentially infected birds, wet the carcass with detergent and water to prevent aerosolization of infectious particles and work under a biological safety cabinet (or equivalent).
- Maintain accurate records of all bird-related transactions to aid in identifying sources of infected birds and potentially exposed people. Records should include the date of purchase, species of birds purchased, source of birds, and any identified illnesses or deaths among birds. In addition, the seller should record the name, address, and telephone number of the customer, and the band numbers if applicable.
- Avoid purchasing or selling birds that have signs of AC (e.g., ocular or nasal discharge, diarrhea, or low body weight).
- Isolate newly acquired birds, (including birds that have been to shows, exhibitions, fairs, and other events) for 30–45 days, and test or prophylactically treat them before adding them to a group.
- Test birds before they are to be boarded or sold on consignment, and house them in a room separate from other birds.
- Practice preventive husbandry. Position cages to prevent the transfer of fecal matter, feathers, food, and other materials from one cage to another. Do not stack cages, and be sure to use solid-sided cages or barriers if cages are adjoining. The bottom of the cage should be made of a wire mesh. Litter that will not produce dust (e.g., newspapers) should be placed underneath the mesh. Clean all cages and food and water bowls daily. Soiled bowls should be emptied, cleaned with soap and water, rinsed, placed in a disinfectant solution, and rinsed again before reuse. Between occupancies by different birds, cages should be thoroughly scrubbed with soap and water, disinfected, and rinsed in clean, running water. Exhaust ventilation should be sufficient to prevent accumulation of aerosols.
- Prevent the spread of infection. Birds requiring treatment should be held in isolation. Rooms and cages where infected birds were housed should be cleaned immediately and disinfected thoroughly. When the cage is being cleaned, transfer the bird to a clean cage. Thoroughly scrub the soiled cage with a detergent to remove all fecal debris, rinse the cage, disinfect it (allowing at least 5 minutes of contact with the disinfectant), and rerinse the cage to remove the disinfectant. Discard all items that cannot be adequately disinfected (e.g., wooden perches, ropes, nest material, and litter). Minimize the circulation of feathers and dust by wet-mopping the floor frequently with disinfectants and preventing air currents and drafts within the area. Reduce contamination from dust by spraying the floor with a disinfectant or water before sweeping it. Do not use a vacuum cleaner, as it can aerosolize infectious particles. Frequently remove waste material from the cage (after moistening the material), and burn or double-bag the waste for disposal. Care for healthy birds before handling isolated or sick birds.
- Use disinfection measures. *C. psittaci* is susceptible to most disinfectants and detergents. A 1:1,000 dilution of quaternary ammonium compounds (e.g., Roccal[®] or Zephiran[®]) is effective, as is 70% isopropyl alcohol, 1% Lysol[®], 1:100 dilution of household bleach (i.e., 2.5 tablespoons per gallon), or chlorophenols. (*C. psittaci* is susceptible to heat but is resistant to acid and alkali.) Many disinfectants are respiratory irritants and should be used in a well-ventilated area. Avoid mixing disinfectants with any other product.

Recommendations for Treating and Caring for Infected Birds

All birds with confirmed or probable AC should be isolated and treated, preferably under the supervision of a veterinarian (Appendix B). Birds with suspected AC or birds previously exposed to AC should be isolated and retested or treated. Because treated birds can be reinfected, they should not be exposed to untreated birds or other potential sources of infection. To prevent reinfection, contaminated aviaries should be thoroughly cleaned and sanitized. Currently, there are no AC vaccines available.

The following general recommendations should be followed when treating and caring for birds with confirmed, probable, or suspected cases of AC:

- Protect birds from undue stress (e.g., chilling or shipping), poor husbandry, or malnutrition. These problems reduce the effectiveness of treatment and promote the development of secondary infections with other bacteria or yeast.
- Observe the birds daily, and weigh them every 3–7 days. If the birds are not maintaining weight, have them reevaluated by a veterinarian.

- Avoid the use of high dietary concentrations of calcium or other divalent cations because they inhibit the absorption of tetracyclines. Remove oyster shell, mineral blocks, and cuttlebone.
- Isolate birds that are to be treated in clean, uncrowded cages.
- Clean up all spilled food promptly; wash food and water containers daily.
- Provide fresh water and appropriate vitamins daily.
- Continue medication for the full treatment period to avoid relapses. Birds may appear clinically improved and have reduced chlamydial shedding after 1 week.

Responsibilities of Physicians and Veterinarians

People exposed to birds with AC should seek medical attention if they develop influenza-like symptoms or other respiratory illness. The physician should collect specimens for laboratory analysis (see Part I), and initiate early and specific treatment for psittacosis. Most states require physicians to report cases of psittacosis to the appropriate state or local health authorities. Timely diagnosis and reporting may help identify the source of infection and control the spread of disease. Local and state authorities may conduct epidemiologic investigations and institute additional disease-control measures (see Local and State Epidemiologic Investigations). Birds that are suspected sources of human infection should be referred to veterinarians for evaluation and treatment.

Veterinarians should be aware that AC is not a rare disease among pet birds. They should consider a diagnosis of AC for any lethargic bird that has nonspecific signs of illness, especially if the bird was purchased recently. If AC is suspected, the veterinarian should submit appropriate laboratory specimens to confirm the diagnosis. Both laboratories and attending veterinarians should follow local and state regulations or guidelines regarding case reporting. Veterinarians should work closely with authorities on investigations and inform clients that infected birds should be isolated and treated. In addition, they should educate clients about the public health hazard posed by AC and the appropriate precautions that should be taken to avoid the risk for transmission.

Quarantine of Birds

The appropriate animal and public health authorities may issue a quarantine for all affected and susceptible birds on a premises where *C. psittaci* infection has been identified. The purpose of imposing a quarantine is to prevent further disease transmission. Reasonable options should be made available to the owners and operators of pet stores. For example, with the approval of state or local authorities, the owner of quarantined birds may choose to a) treat the birds in a separate quarantine area to prevent exposure to the public and other birds, b) sell the birds if they have completed at least 7 days of treatment, provided that the new owner agrees in writing to continue the quarantine and treatment, and is informed of the disease hazards, or c) euthanize the infected birds. After completion of the treatment or removal of the birds, a quarantine can be lifted when the infected premises are thoroughly cleaned and disinfected. The area can then be restocked with birds.

Bird Importation Regulations

The Veterinary Services of the Animal and Plant Health Inspection Service, U.S. Department of Agriculture (USDA), regulates the importation of pet birds to ensure that exotic poultry diseases are not introduced into the United States. These regulations are set forth in the Code of Federal Regulations, Title 9, Chapter 1 (3). Because of the possibility of smuggled pet birds, these import measures do not guarantee that AC cannot enter the United States. In general, current USDA regulations regarding the importation of birds include the following requirements:

- Before shipping the birds, the importer must obtain an import permit from the USDA and a health certificate issued and/or endorsed by a veterinarian of the national government of the exporting country.
- A USDA veterinary inspection must be conducted at the first port of entry in the United States and a quarantine be imposed for a minimum of 30 days at a USDA-approved facility, to determine whether the birds are free of evidence of communicable diseases of poultry. In addition, the birds must be tested to ensure they are free of exotic Newcastle disease and pathogenic avian influenza.
- During the 30-day U.S. quarantine, psittacine birds must receive a balanced, medicated feed ration containing >1% chlortetracycline (CTC) with <0.7% calcium for the entire quarantine period as a precautionary measure against AC. The USDA recommends that importers continue CTC prophylactic treatment of psittacine birds for an additional 15 days (i.e., for 45 continuous days).

Local and State Epidemiologic Investigations

Public health or animal health authorities at the local or state level may need to conduct epidemiologic investigations to help control the transmission of *C. psittaci* to humans and birds. An epidemiologic investigation should be initiated if a) a bird with confirmed or probable AC was procured from a pet store, breeder, or dealer

within 60 days of the onset of signs of illness, b) a person has confirmed or probable psittacosis, or c) several suspect avian cases have been identified from the same source. Other situations may be investigated at the discretion of the appropriate local or state public health departments or animal health authorities.

Investigations involving recently purchased birds should include a visit to the site where the infected bird is located and identification of the location where the bird was originally procured (e.g., pet shop, dealer, breeder, or quarantine station). During such investigations, authorities should consider documenting the number and types of birds involved, the health status of potentially affected persons and birds, locations of facilities where birds were housed, relevant ventilation-related factors, and any treatment protocol. Examination of sales records for other birds that had contact with the infected bird may be considered. To help identify multistate outbreaks of *C. psittaci* infection, local and state authorities should report suspected outbreaks to the Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, CDC, telephone (404) 639-2215.

References

1. CDC. Summary of notifiable diseases, United States, 1997. MMWR 1998;46(54).
2. CDC. Case definitions for infectious conditions under public health surveillance. MMWR 1997; 46(No. RR-10):27.
3. Animal and Plant Health Inspection Service, US Department of Agriculture. 9 CFR Part 92. Importation of certain animals, birds, and poultry, and certain animal, bird, and poultry products; requirements for means of conveyance and shipping containers. Code of Federal Regulations. January 1, 1997:310–429.

Additional Resources

- Flammer K. Chlamydia. In: Altman RB, Clubb SL, Dorrestein GM, Quesenberry K, eds. Avian medicine and surgery. Philadelphia, PA: WB Saunders, 1997:364–79.
- Fudge AM. A review of methods to detect *Chlamydia psittaci* in avian patients. J Avian Med Surg 11(3):153-165, 1997.
- Fudge AM. Avian chlamydiosis. In: Rosskopf WJ Jr, Woerpel RW, eds. Diseases of cage and aviary birds. Baltimore, MD: Williams & Wilkins, 1996:572–85.
- Gerlach H. Chlamydia. In: Ritchie BW, Harrison GJ, Harrison LR, eds. Avian medicine: principles and application. Lake Worth, FL: Wingers Publishing, 1994:984–96.
- Messmer TO, Skelton SK, Moroney JF, Daugharty H, Fields BS. Application of a nested multiplex PCR to psittacosis outbreaks. J Clinical Microbiology. 35(8): 2043-2046, 1997.
- Schaffner W. Birds of a feather—do they flock together? Infect Control Hosp Epidemiol 1997;18:162–4.
- Schlossberg D. *Chlamydia psittaci* (psittacosis). In: Mandell GL, Bennett JE, Dolin R, eds. Mandell, Douglas and Bennett's principles and practice of infectious diseases. 4th ed. New York, NY: Churchill Livingstone, 1995:1693–6.

Appendix A

METHODS FOR DIAGNOSING AVIAN CHLAMYDIOSIS

Pathologic Findings

In birds that have avian chlamydiosis (AC), cloudy air sacs and an enlarged liver and spleen usually are observed, but no specific gross lesion is pathognomonic. The chromatic or immunologic staining of tissue-impression smears can be used to identify organisms.

Culture Technique

Isolation of the etiologic agent, *Chlamydia psittaci*, from the bird's spleen, liver, air sacs, pericardium, heart, or intestines is the optimal means for verifying the diagnosis. *Chlamydia spp* are obligate intracellular bacteria that must be isolated in tissue culture, mice, or chick embryos. Specialized laboratory facilities and training are necessary both for reliable identification of chlamydial isolates and for adequate protection of microbiologists. Consequently, few laboratories perform chlamydial cultures.

In live birds, depending on which clinical signs they exhibit, combined choanal and cloacal swab specimens should be collected, refrigerated, and sent to the laboratory packed in ice, but not frozen. The proper handling of samples is critical for maintaining the viability of organisms for culture, and a special transport medium is required. The diagnostic laboratory should be contacted for specific procedures required for collection and submission of specimens.

Live birds being screened for *C. psittaci* might not shed the microorganism daily. Therefore, to reduce laboratory costs, serial specimens should be collected for 3–5 consecutive days and pooled before being cultured. Tissue samples from the bird's liver and spleen are the preferred necropsy specimens for isolation of *C. psittaci*. Use of culture is recommended to avoid limitations associated with other tests.

Tests for Antibody

A positive serologic test result is evidence that the bird was infected by *C. psittaci* at some point, but it may not indicate that the bird has an active infection. False-negative results may occur for birds that have acute infection when they are sampled before seroconversion. Treatment with an antimicrobial agent may diminish the antibody response.

A single testing method may not be adequate because of the diversity of reactions with immunoglobulins from the various avian species. Therefore, the use of a combination of antibody- and antigen-detection methods is recommended, particularly when only one bird is tested. When specimens are obtained from a single bird, serologic testing is most useful when a) signs of disease and the history of the flock or aviary are considered and b) serologic results are compared with the white blood cell counts and liver-enzyme activities. A greater than fourfold increase in titer of paired samples or a combination of a titer and antigen identification is needed to confirm a diagnosis of chlamydiosis. Some of the advantages and disadvantages of two serologic tests for antibodies are described below.

Direct Complement-Fixation (CF) Test

Direct CF is more sensitive than agglutination methods. False-negative results are possible in specimens from small psittacine birds (e.g., budgerigars, young African grey parrots, and lovebirds). High titers may persist after treatment and complicate interpretation of subsequent tests. Modified direct CF is more sensitive than direct CF.

Elementary-Body Agglutination (EBA)

EBA is commercially available and can detect early infection. Titers >10 in budgerigars, cockatiels, and lovebirds and titers >20 in larger birds are frequently seen in recent infection. However, elevated titers may persist after treatment is completed.

Tests for Antigen

Enzyme-Linked Immunosorbent Assay (ELISA)

ELISA tests (e.g., QuickView[®]), were originally developed for identification of *Chlamydia trachomatis* in humans. The exact sensitivity and specificity of these tests for identifying *C. psittaci* are not known. They are now used to identify *C. psittaci* in birds. These tests give rapid results and do not require live, viable organisms; however, false positive results from cross-reacting antigens can occur. False negative results can occur if insufficient antigen is present. As with all non-culture tests, the results must be evaluated in conjunction with clinical findings. If a bird has a positive ELISA result but is clinically healthy, the veterinarian should attempt to verify that the bird is shedding antigen through isolation of the organism. When a clinically ill bird has a negative ELISA result, a - diagnosis of AC cannot be excluded without further testing (e.g., culture, serologic testing, or polymerase chain reaction [PCR]).

Immunofluorescent-Staining Tests (IFA)

Monoclonal or polyclonal antibodies, fluorescein-staining techniques, and fluorescent microscopy are used to identify the organism in impression smears or other specimens. These tests have similar advantages and disadvantages as ELISA.

Polymerase Chain Reaction (PCR)

A number of laboratories offer diagnostic testing using PCR technology. The PCR test promises to be very sensitive and specific for detection of target DNA sequences in the collected specimens (e.g., choanal and cloacal swabs, blood). Results from tests which have not been validated may be difficult to interpret.

Additional Tests

Additional diagnostic techniques are in use or under development. Readers are encouraged to research peer-reviewed reports on such tests before use.

Laboratories that Test for *C. psittaci*

Many state diagnostic laboratories and veterinary colleges perform routine chlamydial diagnostics. Additional laboratories are listed below; others may be available. Inclusion in this list does not imply endorsement from the Psittacosis Compendium or its constituent institutions.

Animal Health Diagnostic Laboratory (MI)	(517)353-1683	ELISA (antigen), PCR, Culture
AnTech Diagnostics (NJ)	800-745-4725	Monoclonal immunoassay, EBA (TX)
Avian and Exotic Animal Labs (CA)	(310)542-6556	PCR, CF(TX)
California Avian Laboratory	800-783-2473	FA
Comparative Pathology Laboratory (FL)	800-596-7390	IFA(serology), ELISA(antigen)
Infectious Diseases Laboratory (GA)	(706)542-8092	Culture, Cytology, PCR, EBA, IFA
Marshfield Laboratory (WI)	800-222-5835	Culture, EBA(TX), CF(TX)
Research Associates Laboratory (OH)	(513)248-4700	PCR
Texas Veterinary Medical Laboratory	(409)845-3414	Culture, PCR, Gimenez, EBA, CF(Ames)

Appendix B

TREATMENT OPTIONS FOR PET BIRDS WITH AVIAN CHLAMYDIOSIS

Although these treatment protocols are usually successful, knowledge is evolving and no protocol assures safe treatment or complete elimination of infection. Therefore, treatment should be supervised by a licensed veterinarian. In quarantine situations, compliance may be easiest to monitor when treatment is provided by medicated feed. All birds with AC should be treated for 45 days, except as noted below:

Medicated Feed

Medicated feed should be the only food provided to the birds during the entire treatment. Birds' acceptance of medicated feed is variable. Thus, food consumption should be monitored. Acceptance may be enhanced by first adapting the birds to a similar, non-medicated diet. Treatment begins when the birds accept the medicated feed as the sole food in their diet. The following options are available:

- Medicated mash diets (i.e., >1% chlortetracycline [CTC] with <0.7% calcium) prepared with corn, rice, and hen's scratch can be used.)
- Pellets and extruded products containing 1% CTC can be used. They are available and appropriate for use with most pet birds. Select a pellet size appropriate for the size of bird being treated.
- A special diet might be necessary for lorries and lorikeets, which feed on nectar and fruit in the wild.

Medicated Water

Limited pharmacological studies indicate that dosages of 400 mg doxycycline hyclate/liter of water in cockatiels, and 400-600 mg/liter in African grey parrots, blue-fronted Amazon parrots, and Goffin's cockatoos will maintain therapeutic concentrations. Research data is lacking for other species, but empirical use of 400-mg/liter water has been successfully used for many psittacine birds (excluding budgerigars). Drug toxicity can occur when using this regimen so an experienced avian veterinarian should monitor birds during treatment. Signs of toxicity include general signs of illness (depression, inactivity, decreased appetite), green or yellow stained urine, and altered hepatic tests (elevated AST, LD and bile acids). If toxicity occurs, medication should be immediately stopped and supportive care provided until the bird recovers. Treatment with a different regimen can be started at a later date.

Oral Doxycycline

Doxycycline is the drug of choice for oral treatment; either the monohydrate or calcium-syrup formulations can be used. Dosage recommendations are as follows: 40–50 mg/kg body weight by mouth once a day for cockatiels, Senegal parrots, and blue-fronted and orange-winged Amazon parrots; and 25 mg/kg body weight by mouth once a day for African grey parrots, Goffin's cockatoos, blue and gold macaws, and green-winged macaws. Precise dosages cannot be extrapolated for other species; however, 25–30 mg/kg body weight administered by mouth once a day is the recommended starting dosage for cockatoos and macaws, and 25–50 mg/kg by mouth once a day is recommended for other psittacine species. If the bird regurgitates the drug, another treatment method should be used.

Injectable Doxycycline

Intramuscular (IM) injection into the pectoral muscle is often the easiest method of treatment, but not all injectable-doxycycline formulations are suitable for IM injection. All available formulations can cause irritation at the injection site. The Vibrovenos® formulation (Pfizer Laboratories, London) is available in Europe and is effective if administered at doses of 75–100 mg/kg body weight IM every 5–7 days for the first 4 weeks and subsequently every 5 days for the duration of treatment. The injectable-hyclate formulation labeled for intravenous (i.v.) use in humans can be used i.v. in birds. It is not suitable for IM use because severe tissue reactions will occur at the site of injection.

Injectable Oxytetracycline

Limited information exists for the use of an injectable, long-acting oxytetracycline product (LA-200®; Pfizer Laboratories, Exton, Pennsylvania). Current dosage recommendations are as follows: subcutaneous injection of 75 mg/kg body weight every 3 days in Goffin's cockatoos, blue-fronted and orange-winged Amazon parrots, and blue and gold macaws. This dosage may be suitable for but has not been tested on other species. This product causes irritation at the site of injection and is best used to initiate treatment in ill birds or those that are reluctant to eat. After stabilization with oxytetracycline treatment, the birds should be switched to another form of treatment to reduce the muscle irritation that is caused by repeated oxytetracycline injection.

Experimental Methods

Treatment protocols using late-generation macrolides and pharmacist-compounded injectable doxycycline are under investigation. Information about these treatment protocols may be available in the scientific literature or from avian veterinary specialists.

Sources of Medications

These are not listed as an endorsement of said company or products. Other sources may be available.

Avi-Sci Inc.; 4477 South Williams Rd.; St. Johns, MI 48879;800-942-3438;Fax(517)224-9227.

Pretty Bird International, Inc.;5810 Stacy Trl;P.O. Box 177;Stacy, MN55079;800-356-5020.

Rolf C. Hagen (Tropicana®); P.O. Box 9107, Mansfield, MA 02048;800-225-2700;888-BY HAGEN.

Roudybush;P.O. Box 908;Templeton, CA 93456;800-326-1726.

Ziegler Brothers, Inc.;P.O. Box 95;Gardners, PA 17324-0095;800-841-6800.

Some sources of Chlortetracycline for mash diets are:

Aureomycin Soluble Powder Conc (Fort Dodge, FD, IA) 64 gm/lb

Clora-cyclin (RX Veterinary Products, Kansas City, MO) 102.4 gm/25.6 oz

CLTC 100 MR (Pfizer Animal Health, Exton, PA) 22% - 100gm/lb

CTC-50 & CTC Soluble Powder (DurVet, Blue Springs, MO) 11%

Some sources of intravenous doxycycline (powder for injection as hyclate)are:

Vibramycin IV, 100 or 200 mg (Pfizer, New York, NY)

Doxycycline, 100 or 200 mg (Elkins-Sinn, Inc. Cherry Hill, NJ)

Doxy 100 (American Pharmaceutical Partners, Los Angeles, CA)

Vibrovenos IM Doxycycline injection (INAD waiver required to ship into U.S.)

Dr. Gerry Dorrestein, Faculty Veterinary Medicine, Yalelaan 1

3586 CL Utrecht, Netherlands